Lessons Learned on US 30 over UPRR Pier Repair

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IOWA | Department of Transportation

JASPER Construction

WJE

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Presentation Outline

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- Project Introduction
- Project Background
- Bridge Repair and Shoring Design
- Construction and Repair Photos
- Railroad Coordination
- Monitoring Displacement and Vibrations During Construction

Project Location – Wheatland, Iowa

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Project Introduction

Preserve, Rehabilitate, or Replace?

Characteristics to consider

- **Bridge Condition**
- **Bridge Capacity**
- **Bridge Robustness**
- **Bridge Durability**

Project Introduction

- **Bridge Condition**
  - Component condition rating.
  - Element-level condition state.
- **Bridge Capacity**
  - Bridge load rating.
  - Posting, restrictions on loads.
  - Geometrics, alignment, traffic capacity (lanes), vertical clearance, horizontal clearance.
- **Bridge Robustness**
  - Vulnerabilities – Earthquake, fatigue, scour, flooding…
- **Bridge Durability**
  - Resistance to deterioration.

Project Introduction

Bridge utility is like a tube of toothpaste… sort of

Project Introduction

- **Bridge Condition – Yes/No**
- **Bridge Capacity – Yes**
- **Bridge Robustness – No**
- **Bridge Durability – Yes/No**

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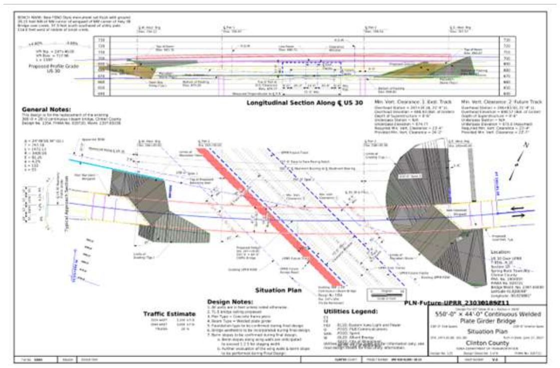
Project Introduction



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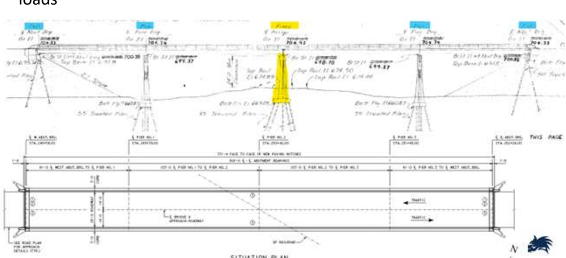
Bridge Background

- Built in 1955
- Four spans: 81’-0” | 103’-0” | 103’-0” | 81’-0”; Total Length = 368’ CL-CL Brgs.
- No skew angle between superstructure and piers; skew to RR > 45°
- Straddle bent at Pier 2 is also the only fixed pier and takes all lateral loads



Straddle Bent (Pier 2)

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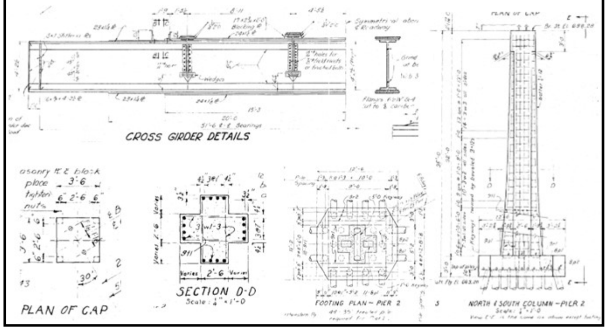
- Cross Girder Spans" 51'-6"
- Square/Cruciform variable column section



Straddle Bent (Pier 2)

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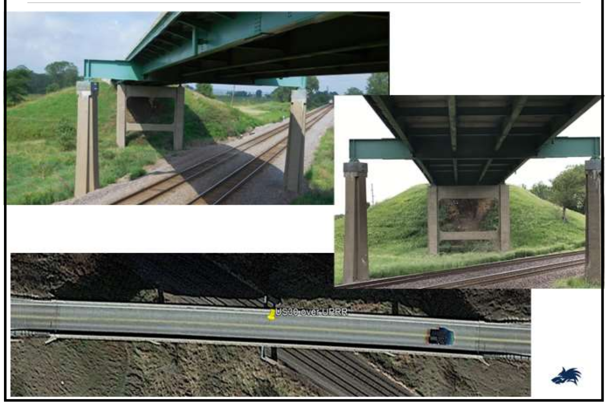

Bridge Repair History

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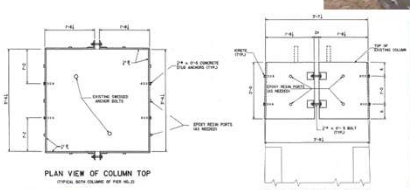
- 1998 repairs included the steel jacket retrofit at the top of the straddle bent columns

DESIGN HISTORY AT THIS SITE

DES. NO.	TYPE OF WORK
1354	ORIGINAL DESIGN
176	OVERLAID & NEW JOINT
598	RE-OVERLAY, RETROFIT BARRIER RAIL, COLUMN REPAIR, JOINT REPAIR
213	NEW BACKWALL & JOINTS



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Current Project Overview

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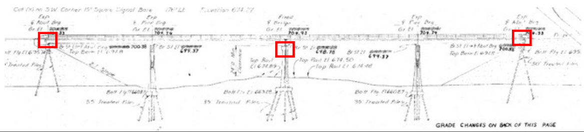
Timeline

- Spring 2024 - Iowa DOT asked MBI to perform a Field Exam of the bridge and create a concept for bridge and column repairs due to concern with the column deterioration
- August 2024 Repair Plans complete
- September 24, 2024 Repair Plans Let
- July 2025 Construction Complete

Field Exam Recommendations

- Pier Columns Concrete Repair – remove unsound concrete and perform concrete repair using shoring
- Abutment Concrete Repairs
- Remove and replace abutment strip seal joint glands
- MOT = keep bridge OPEN with limited full closures for initial jacking of the pier straddle cap



Column Deterioration

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Column Repair Recommendations

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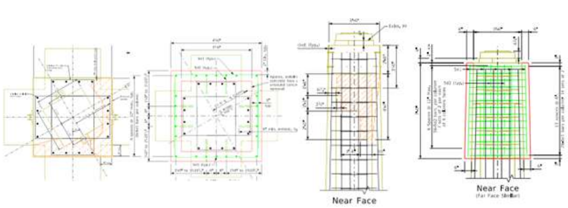
- Install a concrete “collar” 6” wider than the column
- Due to level of deterioration, shoring was recommended
- DOT asked MBI to design and detail the shoring in the Final Plans in order to expedite the RR review.



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Pier Shoring Limitations

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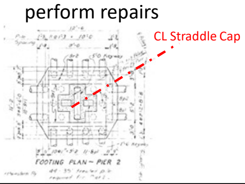
- Proximity to the tracks
- Column shape and variable dimensions
- Column skew relative to straddle cap
- Footing dimension and skew
- Needed to allow contractors to perform repairs



GEOMETRIC DATA			
54 Min Vert UnderClear	R	24'	1"
55 Min Lat UnderClear RT	R	12'	11"

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UPRR Clearances and Constraints

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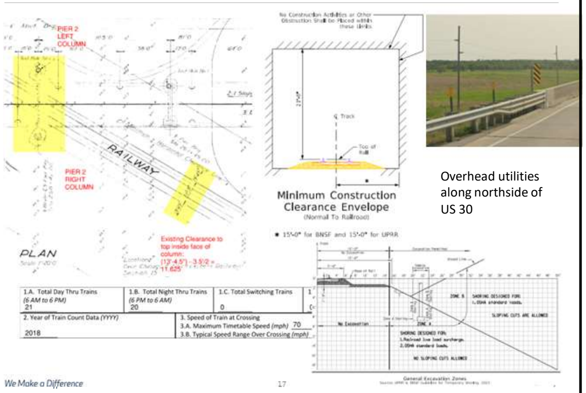

Overhead utilities along northside of US 30

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Pier Shoring and Jacking System

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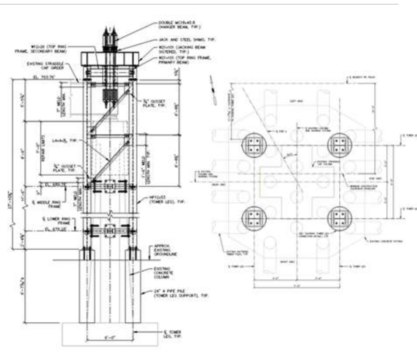
- Steel tower comprised of W-sections
- Concrete filled steel pipe piles sitting on top of existing footing
- Tower braced into the existing column, transfer lateral loads
- Check footing capacity under shored condition



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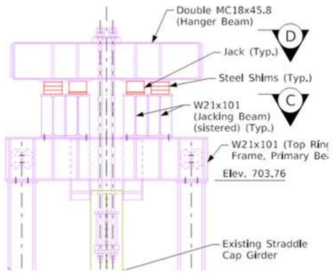
Pier Shoring and Jacking System

- Jacking system is at the top of the tower
- Jacks sit on jacking beams
- Straddle cap "hangs" from rods attached to Hanger Beam
- Provided extensive notes and limitations to jacking, as well as required monitoring

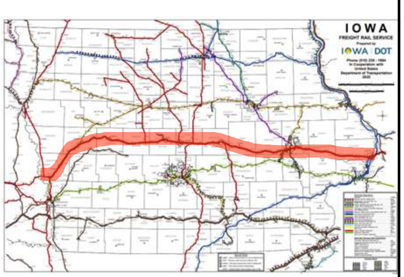


Lessons Learned Repair and Shoring

- Repairs are never straight forward – knowing your options and limitations can play a large factor in the final details.
- Determining shoring is dependent on geometry, utilities and sometimes third party requirements (i.e. the railroad).
- Sometimes we need to be creative with our problem solving

Railroad Coordination

- Location: Bridge over UP double main line (like Iowa's I-235)
- Normally, maintenance with UP is an MCL (Maintenance Consent Letter)
- Unique project – work within the RR clearance envelope.



Railroad Coordination

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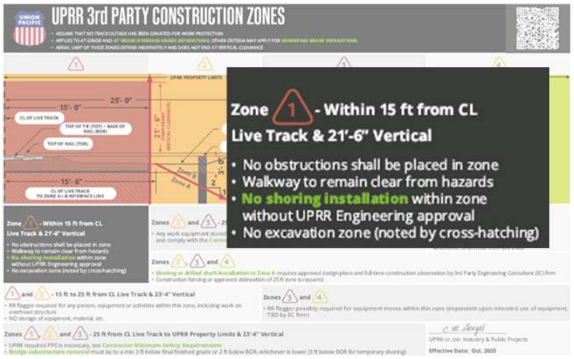

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Railroad Coordination

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- Early communication with the railroad is critical
- Rehabilitation Concept:
  - Not emergency repair
  - Original project development timeline did not anticipate complex RR agreement
- Constructability review with AGC (5/2/2024)
  - Expedite the reviews with showing more information in design plans instead of leaving temporary or construction engineering up to the contractor
- Track survey was not obtained

Field measurements by contractor revealed that the CL track was actually 10" closer than shown in the plans and inventory documents.

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Railroad Coordination

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- UP approved 100% plans – with shoring details.
- UP agreed that the original C&M (construction and maintenance agreement) is still in effect
- UP agreed to a Letter of Authorization (9/3/2024)
  - Not an MCL due to the work in clearance zone
  - Required payment for UP Construction Observation, in addition to flagging (up to $100,000)
  - Much faster than negotiating a new C&M
  - Included allowance for Fall 2024 inspection due to delayed construction start in Spring 2025
- Jasper Construction
  - Coordinated with UP on work plan and work windows
  - Project was becoming an emergency repair due to delays
  - DOT contacted UP to expedite reviews of contractor submittals

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Railroad Coordination

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June 4, 2025
During
Construction

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Railroad Coordination Lessons Learned

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- Consider railroad impacts early in development
- Require a survey for all projects near the track that could be impacted by the track clearances
  - Easier to identify and resolve issues during design phase
- Consider holding a constructability review with AGC partners
  - Complex projects
  - Include appropriate construction elements in the plans and get advance approval from railroad
  - Understand work window requirements so contractors can better understand and bid the project

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Construction Photos

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Construction Photos


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Construction Photos

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Displacement and Vibration Monitoring

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- WJE instrumented and monitored the structure
- Monitoring for several reasons:
  - Movement of existing footings due to installation of shoring on top
  - Movement of the shoring tower
  - Any tilt or displacement of the straddle cap under jacked condition
- Monitoring Limits:
  - Alert Limit = Pause work to assess what is going on
  - Shut Down Limit = Stop all work and inspect the bridge
  - Needed to calibrate the limits to the tolerances and baseline readings of the monitors

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Displacement and Vibration Monitoring

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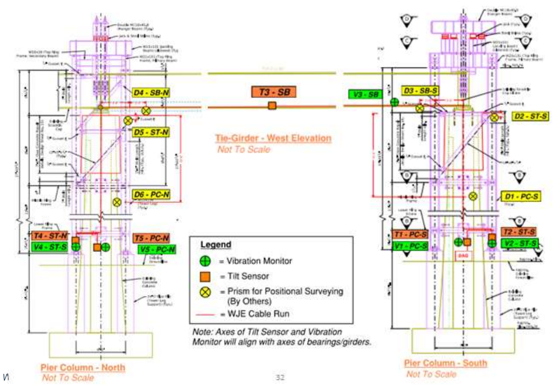

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Determination of Monitoring Limits

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- Alert Limit = Pause work to assess what is going on
- Shut Down Limit = Stop all work and inspect the bridge
- Needed to calibrate the limits to the tolerances and baseline readings of the monitors

Bridge Element	Sensor ID	Out-Plane Displacement (Longitudinal to Bridge) (+/- Inches)		In-Plane Displacement (Transverse to Bridge) (+/- Inches)		Vertical Displacement (+/- Inches)	
		Alert Limit	Shut Down Limit	Alert Limit	Shut Down Limit	Alert Limit	Shut Down Limit
South Pier Column	D1-PC-S	1/2	5/8	1/4	3/8	1/4	3/8
South Shoring Tower	D2-ST-S	1/4	1/2	1/4	3/8	1/4	1/2
Straddle Beam	D3-SB-S	1/4	1/2	1/4	3/8	1/4	1/2
Straddle Beam	D4-SB-N	1/4	1/2	1/4	3/8	1/4	1/2
North Shoring Tower	D5-ST-N	1/4	1/2	1/4	3/8	1/4	1/2
North Pier Column	D6-PC-N	1/2	5/8	1/4	3/8	1/4	3/8

Bridge Element	Sensor ID	Sensor Axes	A-Axis Rotation (+/- Degrees)		B-Axis Rotation (+/- Degrees)	
			Alert Limit	Shut Down Limit	Alert Limit	Shut Down Limit
South Pier Column	T1-PC-S	A'-B'	0.11	0.16	0.21	0.26
South Shoring Tower	T2-ST-S	A'-B'	0.05	0.08	0.05	0.11
Straddle Beam	T3-SB-S	A-B	0.99	1.39	1.72	2.27
North Shoring Tower	T4-ST-N	A'-B'	0.05	0.08	0.05	0.11
North Pier Column	T5-PC-N	A'-B'	0.11	0.16	0.21	0.26

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Communication of Monitoring

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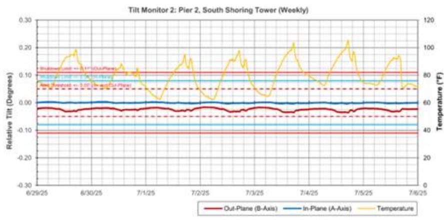
- Weekly reports from WJE summarizing the readings from the field



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Communication of Monitoring

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- Group emails including DOT, MBI, WJE and Jasper when values would exceed thresholds
- WJE would follow up the alert emails with a reason for the alert and if construction was OK to proceed

EXTERNAL EMAIL

This is an email alert message notifying the US30 UPRR project team of the following event:

The Pier 2 South Shoring Tower (T2-ST-S) exceeds the out-of-plane (E-W) Tilt Alert Threshold Value.
Current Value: 0.2712601 deg
Alert Threshold: 0.05 deg
Shut Down Limit: 0.08 deg

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Communication of Monitoring

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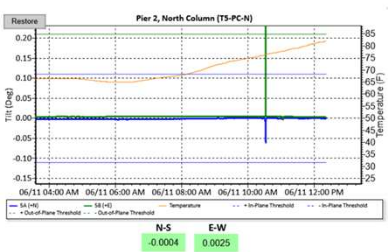
- Website access with live feed of monitoring



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Lessons Learned for Monitoring

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- Work with the experts to set reasonable levels for alerts
- Having a clear communication plan is key to handling alerts
  - Communication plans should include:
    - A contact person for each stakeholder
    - Different levels of alerts: Threshold alerts and Stop Work alerts
    - Communication chain for who is notified for each level of alert
    - Plan for response
- Before monitoring begins, identify events that are most likely to cause different alerts
  - We knew based on the sensor locations, we had a high risk of accidental contact
  - Recognizing this early made it easier to identify and clear alerts from accidental contact

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Conclusion

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- Sometimes we get to be creative with our engineering
- Use the existing structure as needed for shoring, isolate where you need to remove the load
- Always require survey to confirm track locations, even on a repair
- Coordinate with RR early for complex repairs
- Expedite RR reviews with providing temporary structure design and details in the plans
- The best monitoring plan has a robust communication plan

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Questions?